Claims

1. Apparatus for injecting a substance into a surface which apparatus comprises a needle, a container for the substance to be injected, a means for applying the substance from the container to the tip of the needle, a means for driving the needle to penetrate the surface and deliver the substance thereto which means comprises a block slidably mounted in a conduit which block is accelerated by a controlled force to strike the needle assembly thereby inducing an acceleration of the needle to drive it into the surface.

2. An apparatus as claimed in claim 1 in which, in use, the majority of the energy for penetration after contact with the surface comes from the momentum of the needle and associated moving parts and not from the continued force of the driving means.

3. Apparatus as claimed in any one of claims 1 or 2 in which the driving means is pneumatically operated.

4. An apparatus as claimed in any one of claims 1 to 3 in which there is a stopping means incorporated in the driving means adapted to bring the needle to a rapid stop

5. Apparatus as claimed in claim 4 in which the driving means comprises a block slidably mounted in a conduit so that application of a pneumatic force or spring at one end of the conduit will propel the block at speed down the conduit, so that it will strike an end piece which forms part of, or is connected to the end of the needle.

6. Apparatus as claimed in claim 6 in which there are means to generate a pulse of gas in the conduit which propels the block down the conduit.

7. Apparatus as claimed in claim 5 or 6 in which the end of the block is tapered and fits into the end of a corresponding shaped tube connected to a source of compressed

air so as to form a plug valve at the end of the tube, there being means to move the block away from the end of the tube.

8. Apparatus as claimed in claim 6 or 7 in which there are means to return the block to its original position by reduction of pressure in the conduit.

9. Apparatus as claimed in claim 8 in which there are means to apply a plurality of pulsed impulses to the plate and means to withdraw the block back down the conduit between pulses.

10. Apparatus as claimed in claim 9 or 10 in which the block and needle are connected so that as the block is returned to its original position or withdrawn down the conduit the needle is withdrawn from the surface.

11. Apparatus as claimed in any one of claims 3 to 10 in which the means to propel the block down the conduit comprises hand bellows, a piston and return spring or a pre-compressed gas or motor driven gas pump.

12. Apparatus as claimed in any one of claims 8 to 10 in which there is a means to reduce the pressure in the conduit below the block in the direction the block moves so that a partial vacuum is formed.

13. Apparatus as claimed in any one of claims 4 to 12 in which there is provided a means to apply a plurality of blows to the needle so that the needle penetrates a controlled distance into the skin at each blow until the needle is driven in to the desired depth.

14. Apparatus as claimed in claim 13 in which there are two or more blocks mounted within the conduit so that, in use, a plurality of blows impact on the end piece.

15. Apparatus as claimed in claim 13 in which the needle and block are slidably connected together and spaced apart so that they are propelled down the conduit together and, when the needle enters the skin and stops, the block continues and strikes the end of the needle.

16. Apparatus as claimed in any one of the preceding claims in which the feed of the substance to the needle is discontinuous.

17. Apparatus as claimed in any one of the preceding claims in which the needle is separate and adjacent to a syringe containing the substance to be injected with one end of the needle fluidically and flexibly connected to the end of the syringe and there being sufficient flexibility in this connection so that rapid acceleration and movement of the needle is not significantly inhibited by its connection to the syringe.

18. Apparatus as claimed in claim 17 in which the needle is coiled, looped or zig-zagged.

19. Apparatus as claimed in any one of the preceding claims in which there is a syringe which has a piston mounted therein with the needle projecting through the end of the syringe and the other end of the needle having an extension projecting through the piston so the end of the extension can be struck by a driving means to drive the needle into a surface, there being a connection means between and the needle whereby a substance in the syringe can pass through the needle from the syringe as the piston is depressed.

20. Apparatus as claimed in any one of claims 16 to 19 in which part of the momentum of the moving block can be transferred to the syringe plunger to induce pressure which injects a quantity of the substance to be injected into the skin.

21. Apparatus as claimed in any one of the preceding claims in which there is a needle guide through which the needle can slide in use to restrict transaxial or lateral movement of the needle.

22. An apparatus as claimed in claim 21 in which the needle guide restricts the transaxial or lateral movement of the needle to below +/- 2 degrees.

23. An apparatus as claimed in claim 22 in which the needle guide restricts the transaxial or lateral movement of the needle to below +/- 0.5 degrees.

24. An apparatus as claimed in claim 21 in which the needle guide restricts the transaxial or lateral movement of the needle to below +/- 0.1 degree.

25. Apparatus as claimed in any one of the preceding claims in which there are means, in use, to drive the needle at a velocity of from 1 metre per second to 100 metres per second in order to penetrate the skin and deliver the substance thereto.

26. An apparatus according to claim 25, wherein the needle driving means, in use, drives the needle at a velocity in the range of 5 to 50 metres per sec.

27. An apparatus according to claim 25, wherein the needle driving means drives the needle at a velocity in the range of 10 to 20 metres per sec.

28. An apparatus as claimed in any one of the preceding claims in which the means for driving the needle, in use can accelerate the needle at 1 to 20,000g

29. An apparatus as claimed in any one of the preceding claims in which the mass of the fluid to be injected is below 1 gram and the container for the fluid is incorporated with the needle.

30 . An apparatus as claimed in any one of the preceding claims in which the mass of the needle and associated moving parts is 0.01 to 5.0grm.

31. An apparatus as claimed in any one of the preceding claims in which the mass of the needle and associated moving parts is 0.1 to 3grms.

32. An apparatus as claimed in any one of the preceding claims in which the mass of the needle and associated moving parts is 0.2 to 0.6grm.

33. An apparatus as claimed in any one of the preceding claims in which the mass of the block 0.8 to 3 times the needle holder mass.

34. An apparatus as claimed in claim 33 in which the mass of the block is from one to twice the needle holder mass.

36. Apparatus as claimed in any one of the preceding claims in which the substance to be delivered is fed under normal, manual or mechanical pressure to the needle by means of a syringe or a compressible sack.

37. Apparatus as claimed in any one of the preceding claims in which there are means to repeat the cycle of needle entry, substance delivery, needle withdrawal.

38. Apparatus as claimed in claim 37 in which the rate of injections from 1 to 50 per second.

39. Apparatus as claimed in any one of the preceding claims in which the needle is hollow with at least one aperture connecting to core directly adjacent to the tip to allow injections to be made at a depth of less than 1mm below the skin surface.

40. An apparatus as claimed in any one of the preceding claims in which the needle has substantially non-cutting tip with substantially no sharpened edges or blades with smooth, tapered, radiused or bevelled edges or surfaces.

41. Apparatus as claimed in any one of the preceding claims in which the needle is conical or with a radiused point and one or more slots are present which connect the core to the exterior to allow, in use, delivery of the substance below skin surface and in which when the needle is entering the skin the one or more slots are substantially closed to prevent entry of external material or tissue into the core.

42. Apparatus as claimed in claim 41 in which when fluidic pressure is applied from the core to the exterior and the dimensions of the one or more slots increases to allow greater flow of fluidic substance.

43. Apparatus as claimed in claim 41 in which the one or more slots are linear and parallel to the needle axis, inclined at an angle to the axis, spiral in form or are arranged to define a moveable flap which closes like a valve when external pressure is applied to the needle and opens like a valve when internal pressure is applied.

44. Apparatus for injecting a substance into a surface as hereinbefore described with reference to the drawings.

45. A method of delivering a substance by employing an apparatus according to any of the preceding claims.

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